Impact of Agricultural and Trade Policy Reform on land-use within the EU

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I. Introduction

Various concerns have been raised that reforms to European agricultural and trade policy will lead to widespread land abandonment across Europe and that this will have negative environmental and social consequences. In fact, this case was made strongly during the 2003 reform process where, as noted by the European Commission,[1] some Member States considered that full decoupling could lead to several risks such as the abandonment of production, the lack of raw material supply for processing industries, or to social and environmental problems in areas with few economic alternatives. For this reason the Single Payment Scheme included a significant degree of national discretion in implementation (including the use of Article 69[2]) and allowed member states to retain some elements of the former coupled direct payments either in part or in their entirety.

Land abandonment is complex because it is multi-dimensional and does not relate to a single or simple issue. In some areas it may be viewed as an economic issue, in others more environmental and in yet others social or cultural. Therefore, much of the political significance of change in land use or farm structure derives from local context. Understanding the potential scale of this 'problem' is therefore important to decisions on the future of agricultural and trade policy.

The purpose of this paper is twofold: (i) to examine whether or not the proposition that agricultural and trade reform will lead to widespread land abandonment across Europe is realistic and; (ii) to assess the wider environmental consequences of possible reforms. To achieve these aims, the paper is the first to use a modified version of the CAPRI model (modified to include a regional land supply model) that is able to both capture the nuances of agricultural support and also simulate the movement of land in and out of agricultural use.

II Modelling approach

II.1 Model description and scenario design

In view of the issues and challenges in quantifying the possible impacts on land-use, the use of a well established EU wide modelling framework capable of capturing the complexities of the implementation of alternative policies at the regional level is the most appropriate approach. The CAPRI model offered considerable advantages for this purpose, not least because of its broad sectoral coverage, the level of regional disaggregation and its ability to capture the complex interdependencies between sectors.[3] However, whilst this framework is spatially disaggregated to a greater degree than other modelling frameworks, it is still too aggregated for the requirements of a study on land abandonment. Therefore, the simulation of land use change and associated impacts is based on the use of multiple models to address the different scales of analysis and multiple inputs (Hellmann and Verburg, in press; Verburg et al., 2008).

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[1] See CAP Health Check proposals http://ec.europa.eu/agriculture/healthcheck/prop_en.pdf

[2] Article 69 of Council Regulation (EC) No 1782/2003. This Regulation established the legal framework for the Single Payment Scheme. Article 69 allowed for up to 10% of single payment ceilings to be effectively re-coupled and used to subsidise 'specific types of farming which are important for the protection or enhancement of the environment, or for improving the quality and marketing of agricultural products'.

[3] See http://www.ilr1.uni-bonn.de/agpo/rsrch/capri/capri_e.htm for further details

We have adopted an approach, which, drawing on existing solutions to the modelling of land-use cover change and competition for land use, enriches the existing regionalized agricultural sector model CAPRI (Common Agricultural Policy Regionalized Impact) by developing regional land markets. The CAPRI model has been extensively employed in applied policy impact analyses in the EU as it implements both a regionalized agricultural supply model with detailed production technology and a world trade model for agricultural and food commodities.[4]

A modelling chain consisting of the CAPRI and the Dyna-CLUE models was implemented with the addition of a number of specific models for indicators of environmental change. The main external driving factors that are specified as inputs to the models are demography, overall economic development (GDP), technological change and government policies. Economic and policy changes and interactions with regions outside Europe are simulated using the CAPRI model with output at the level of NUTS2 administrative level. Within Europe a more detailed assessment is made of the spatial patterns of land use change in order to identify which regions are expected to face specific land use change processes. A spatially explicit land allocation model, CLUE (Conversion of Land Use and its Effects, Dyna-CLUE version (Verburg and Overmars, 2009) was used with a spatial resolution of 1 km^2 for yearly time steps. Seventeen different land use types are distinguished based on the CLC2000/CORINE land cover database including built-up area, rainfed arable land, pasture, (semi-)natural vegetation, inland wetlands, irrigated arable land, recently abandoned farmland, biofuel crops, permanent crops, forest, and a number of different distinct (semi-) natural land use types such as beaches, glaciers, etc.

The CLUE model is based on the dynamic simulation of competition between land uses while the spatial allocation rules are based on a combination of empirical analysis of current land use patterns (Verburg et al., 2006a; Wassenaar et al., 2006), neighborhood characteristics (Verburg et al., 2004a), and scenario specific decision rules. The spatial allocation rules are configured separately for each country to account for the country-specific context and land use preferences. The land requirements for the different land use types to be allocated by the model are specified at the national scale for each country within Europe separately as follows:

- Changes in agricultural land area are based on the results of the CAPRI simulations. (CAPRI is configured with land supply curves based on a set of prior simulations with the CLUE model)
- Growth in built-up area is based on demographic development, immigration ratios and scenario-specific estimates of change in area used per person
- Changes in natural vegetation are the result of both net changes in agricultural and built-up area and locally determined processes of re-growth of natural vegetation (Verburg and Overmars, 2009). After abandonment of agricultural land re-growth of natural vegetation is determined by the local growing conditions (soil and climate conditions), population and grazing pressure and management. The possibilities to convert natural vegetation into agricultural land or residential/industrial land depend on the location and the type of natural area. Path-dependent dynamics arise from the combination of top-down allocation of agricultural and urban demand and bottom-up simulation of the (re-) growth of natural vegetation.

[4] The project website www.capri-model.org provides an updated list of the applications of CAPRI

The configuration of CAPRI with land supply curves based on a set of prior simulations with the CLUE model is a major development of the CAPRI model. Previously the model assumed that total land area was fixed as was the quantity allocated to crops and grass. The process of modifying the model is reported in detail within Jansson et al (2009).

To aid analysis of the possible environmental impacts of reform of agricultural and trade policies, a number of indicators are calculated based on the spatial modeling results.

i) A land abandonment indicator summarizes the high-resolution results by areas of concentrated abandonment.

ii) A biodiversity indicator is derived based on the GLOBIO approach for the European context and accounts of different pressures on biodiversity.

iii) An index of erosion is used as a measure of sustainable management of natural resources. The index is based on a European version of a common approach to estimate erosion (Universal Soil Loss Equation).

All three indicators are described in more detail in Appendix 2 of Renwick *et al* (2010). However, it should be noted that the approach by which the biodiversity indicator is calculated is biased towards species abundance in (semi-)natural ecosystems; agro-biodiversity is therefore not strongly accounted for. This needs to be accounted for in any interpretation of the results.

Baseline and Scenarios

Three future scenarios are examined and these are compared to a baseline situation. The baseline assumes that the CAP "Health Check" reform is implemented and that the resulting policies continue up to 2020. In particular: milk quotas are abolished; sugar quotas kept in place; there is no compulsory set-aside and; direct payments are further decoupled. Of the formerly coupled payments of the first pillar, only the following remain coupled in the baseline (to the extent that each member state has utilised the coupling option): Suckler cow premiums; direct payments for sheep and goats and; various payments to fruits and vegetables and wine.5 The three scenarios considered within the study are:

- Scenario 1 (No Pillar 1) consists of the removal of all Pillar 1 payments and all market support measures across the EU
- Scenario 2 (WTO) assumes that the proposals put forward at the stalled WTO talks are implemented
- Scenario 3 (Liberalisation) is a combination of Scenario 1 and Scenario 2

Seven countries were identified for more detailed analysis (Germany, Greece, Spain, France, Poland, Hungary and the UK). These countries were chosen to reflect the diversity of agricultural and institutional structures across the EU.

II.2 Results

II.2.1 Prices and Production

The estimated impacts on overall levels of production within the EU of the agricultural and trade reforms captured in the three scenarios are, in the main, relatively small (Table 1). Given the concern expressed over the potentially detrimental effects arising from the removal of Pillar 1 payments and trade liberalisation on EU agriculture, it might seem surprising that the reforms are predicted to have such a relatively small

[5] Further information on the development of baselines in CAPRI can be found at http://www.capri-model.org/refrun.htm

impact at the aggregate level. However, the initial shock of reform appears to lead to a process of market adjustment that mitigates the overall impact. In addition, the fact that key commodities (beef, dairy products etc.) have been included as sensitive products and therefore subject to reduced tariff cuts, dampens the impact of trade reform on EU agriculture. The results are also consistent with earlier work, for example Philippidis et al (2007) using the GTAP model, found relatively small price and production changes at the EU level for many commodities under various trade and CAP reform scenarios.

Though overall production levels remain fairly stable under the reform scenarios, there are more noticeable changes in terms of land use and livestock numbers both at the EU and individual country level. Shifts in the relative profitability of enterprises lead to quite marked shifts in land-use as a result of Pillar 1 reform (Table 2).

Table 1 Impact of Scenarios on EU prices and production of key agricultural commodities+ (EU27)

	Price			Production		
Product	S1	S2	S3	S1	S2	S3
			Per cent			
Cereals	9.90	-0.48	7.61	-1.18	-0.31	-3.28
Oilseeds	6.29	0.26	6.47	-7.14	-0.52	-7.26
Other arable field crops	1.64	-1.57	0.13	0.24	0.08	-0.76
Vegetables and Permanent crops	0.41	0.13	0.50	-0.03	0.02	-0.01
Meat	2.50	-4.70	-2.40	-1.16	-1.13	-2.27
Other Animal products	2.35	2.40	4.47	-0.85	1.65	1.00
Dairy products	-0.94	-1.33	-2.03	-0.15	-1.98	-2.07
Oils	2.13	-0.80	1.23	-0.33	-1.39	-1.72

Notes + All figures shown are percentage differences from the baseline situation

For example, under S1, pasture declines by just over 10 per cent in the EU27 and arable by over 6 per cent. The level of decline is greater in the EU10 at 13 and 8 per cent for pasture and arable, respectively. Trade liberalisation (S2) in itself appears to have relatively little impact on land-use. This suggests that the Pillar 1 payments and the associated commitments in terms of cross-compliance maintain land in use. For the EU27 as a whole, the area utilised for agriculture (UAA) declines by around 8 per cent under the CAP reform scenarios when compared to the baseline. The combination of agricultural and trade reform (S3) leads to the most significant changes in land use.

Although all countries studied witness a decline under S1 in land utilised for pasture and arable, the extent of the decline varies quite markedly as does the balance of the decline between the two categories. Greece, for example, is predicted a significant fall in both pasture and arable (16 and 13 per cent, respectively) whilst Spain has a much greater reduction in pasture than arable land (13 per cent compared with 3). The variation across EU countries may reflect the extent that specialisation has occurred in the agricultural sector. For example, in the UK where a high degree of specialisation has happened, arable land falls by a small percentage. This may be because arable production is already situated on the most suitable land. However, in countries such as Germany, where mixed farming is more prevalent, arable production is probably still occurring in more marginal areas.

Table 2 also presents the overall impact of these changes in terms of utilised agricultural area under the three scenarios. When the figures are disaggregated by country the extent of the fall in farmed area varies from just over 7 per cent for the UK up to over 14 percent for Greece under S3.

Breaking the figures down by farm type and by farm size gives further insight into the impacts of the reforms (Table 3). In the majority of countries, as might be expected, it is the grazing livestock categories (for example sheep and goats) where UAA falls most significantly (around 25 per cent). Interestingly this is not the case for France where specialist fruit and dairying are most affected. In general, a greater proportion of land on smaller holdings (as measured by economic size unit), appears to become idle under the reforms. Again, France appears to be an outlier, perhaps reflecting that it is in the more intensive sectors of dairying and fruit production that the reduction in UAA is the greatest.

Table 2 Changes in Pasture, Arable and UAA by EU Group and Selected Countries+

	S1 (No Pillar 1)			S2 (WTO)			S3 (Liberalisation)		
	Pasture	Arable	UAA	Pasture	Arable	UAA	Pasture	Arable	UAA
EU27	-10.44	-6.45	-7.82	-0.12	-0.19	-0.16	-10.72	-7.06	-8.32
EU25	-10.15	-6.50	-7.76	-0.11	-0.19	-0.16	-10.42	-7.15	-8.28
EU15	-9.69	-6.03	-7.40	-0.12	-0.24	-0.19	-10.00	-6.76	-7.97
EU10	-13.19	-8.03	-9.20	-0.04	-0.04	-0.04	-13.25	-8.45	-9.54
Germany	-8.50	-8.64	-8.60	-0.08	-0.60	-0.46	-8.77	-9.71	-9.46
France	-8.36	-6.35	-7.02	-0.08	-0.24	-0.19	-8.59	-7.07	-7.58
Spain	-13.44	-3.00	-6.76	-0.16	-0.10	-0.12	-13.65	-3.72	-7.29
Greece	-15.56	-13.33	-14.07	-0.06	-0.09	-0.08	-15.70	-13.95	-14.53
United Kingdom	-8.72	-2.61	-6.44	-0.25	-0.03	-0.17	-9.52	-3.20	-7.16
Hungary	-18.40	-5.55	-7.65	-0.06	-0.03	-0.04	-18.23	-6.12	-8.10
Poland	-13.28	-9.58	-10.31	0.01	-0.06	-0.05	-13.31	-9.98	-10.63

Notes + All figures shown are percentage differences from the baseline situation

Changes in land-cover are important when considering the environmental implications of the proposed reforms, but clearly the intensity that the land is utilised is also important. Some indication of this can be derived from the CAPRI model which provides information on livestock numbers.

Dairy and beef based on dairy calves are only marginally hit by the reforms captured in S1 (under one per cent for dairy and around two per cent for beef production). More marked declines are witnessed in suckler cow production with a predicted fall of just over 12 per cent (ranging from a negligible change in Germany to a 23 per cent reduction in Greece). The variation in the impact on suckler cow numbers across countries may also be related to the way in which the 2003 reforms were implemented. For example (with the exception of the Scottish Beef Calf Scheme) the UK fully decoupled all payments including those to livestock. France and Spain did not fully decouple. Therefore, they are effectively moving from a situation where production was partially coupled and a greater level of adjustment might be expected.

Sheep and goat numbers also decline under the reforms, with both CAP reform and trade liberalisation leading to lower numbers. When the reforms are combined under S3, falls of between five and six per cent are predicted. The impact is greater in the old rather than new member states.

Overall, the change in utilised area does appear quite marked when compared to the estimated changes in production and livestock numbers. This infers that it is the more marginal areas (least productive) where production is ceasing. It also suggests that farmers at the intensive margin are responding to the price changes associated with CAP reform and increasing production. Together, these two factors point to the reform improving the overall efficiency of production across the EU27.

Table 3 Change in Utilised Agricultural Area by Farm Type and by Farm Size under Pillar 1 removal

Farm Type/Size	EU27	Spain	Greece	Germany	France	Hungary	Poland	UK
Specialist cereals, oilseed and proteins	-11.5	-6.2	-11.2	-6.7	-8.2	-8.0	-9.6	-1.8
General field/mixed cropping	-11.8	-5.2	-15.2	-7.1	-7.2	-7.0	-10.3	-1.2
Specialist cattle-rearing and fattening	-14.1	-11.0	..	-13.8	-5.1		-12.6	-10.0
Sheep, goats and other grazing livestock	-25.2	-13.7	-16.0	-25.2	-6.7	-13.2	-15.5	-10.8
Specialist horticulture	-1.0	-0.4	..	..	..	..	..	..
Specialist vineyards	-2.5	-0.9	..	-1.3	-2.2	..	..	..
Specialist fruit and citrus fruit	-2.1	-0.9	..	..	-9.9	..	..	..
Mixed crops-livestock	-11.3	-8.3	-15.3	-8.4	-7.9	-6.0	-9.8	-2.9
Specialist dairying	-12.6	-12.5	..	-10.3	-9.3	-5.7	-13.1	-3.4
Specialist granivores	-11.4	-3.7	-3.1	-13.6	-8.3	-14.3	-6.5	-2.4
Mixed livestock holdings	-12.9	-9.2	-18.3	-9.8	-8.4	-7.1	-10.0	..
Various permanent crops combined	-15.8	-2.8	-12.1	..	..	..	..	..
Specialist olives	-19.7	-6.6	-17.4	..	..	..	..	..
Other farm types (aggregated)	-	-7.7	-10.3	-9.2	-4.9	-7.5	-11.3	-3.3
By Size								
< 16 ESU	-17.0	-8.2	-16.3	-15.0	-4.9	-7.3	-10.8	-9.2
> 16 < 100 ESU	-14.4	-5.7	-12.9	-10.1	-7.3	-8.0	-7.4	-9.4
>100	-9.7	-5.1	0.0	-6.5	-8.1	-7.8	-7.4	-3.2

Notes + All figures shown are percentage differences from the baseline situation

II.2.2 Environmental Indicators

The CAPRI model provides two useful indicators of the environmental pressures arising from agriculture, namely changes in nutrient surpluses (nitrate, phosphate and potassium) and greenhouse gas emissions (ammonia, methane and nitrous oxide).[6] The decline in utilised area coupled with smaller livestock numbers and changed cropping patterns leads to a fall of around 4 (5) per cent for potassium and phosphate and just over 2 (3.5) per cent for nitrate under S1 (S3). The smaller impact of trade liberalisation (S2) on agricultural production is reflected in smaller changes. On a per utilised hectare basis, there is actually a general increase in nutrient surpluses (the exception being nitrates under S2). This adds support to the hypothesis that some intensification is occurring on the land remaining in production.

Although for the EU as whole nutrient surpluses are predicted to fall under all the reform scenarios, the picture is not quite so clear cut at the country level. Nitrate and Phosphate surpluses decline for all countries under Scenario 1. This is most marked for nitrates in Germany and Poland (with declines of over 8 per cent) and for phosphate in

[6] Details of how these are calculated can be found at www.capri.com

Spain and Poland (falling by 6 and 8 per cent, respectively). Further examination highlights that this reflects changes in cropping patterns (for example Germany and Poland have the largest reduction in cereal area as a result of the reforms) as well as land leaving production. Potassium surpluses increase significantly for Hungary and Germany (and marginally in UK) with the removal of Pillar 1. Similar to the EU analysis above, Scenario 2 leads to smaller changes in overall surpluses.

The reduction in livestock numbers and areas cultivated leads to reductions in the key greenhouse gases from agriculture. For example under Scenario 3, ammonium output falls by around 3 per cent, methane by around 4 per cent and nitrous oxide by around 5 per cent across the EU27. At the country level, the pattern highlighted for nutrient surpluses is reflected in the predicted changes in GHG emissions. For example, Germany and Poland have the largest reduction in Nitrous Oxide emissions under Scenario 1 (of around 6 per cent) reflecting the changed patterns of land-use.

II.2.3 Spatial Analysis

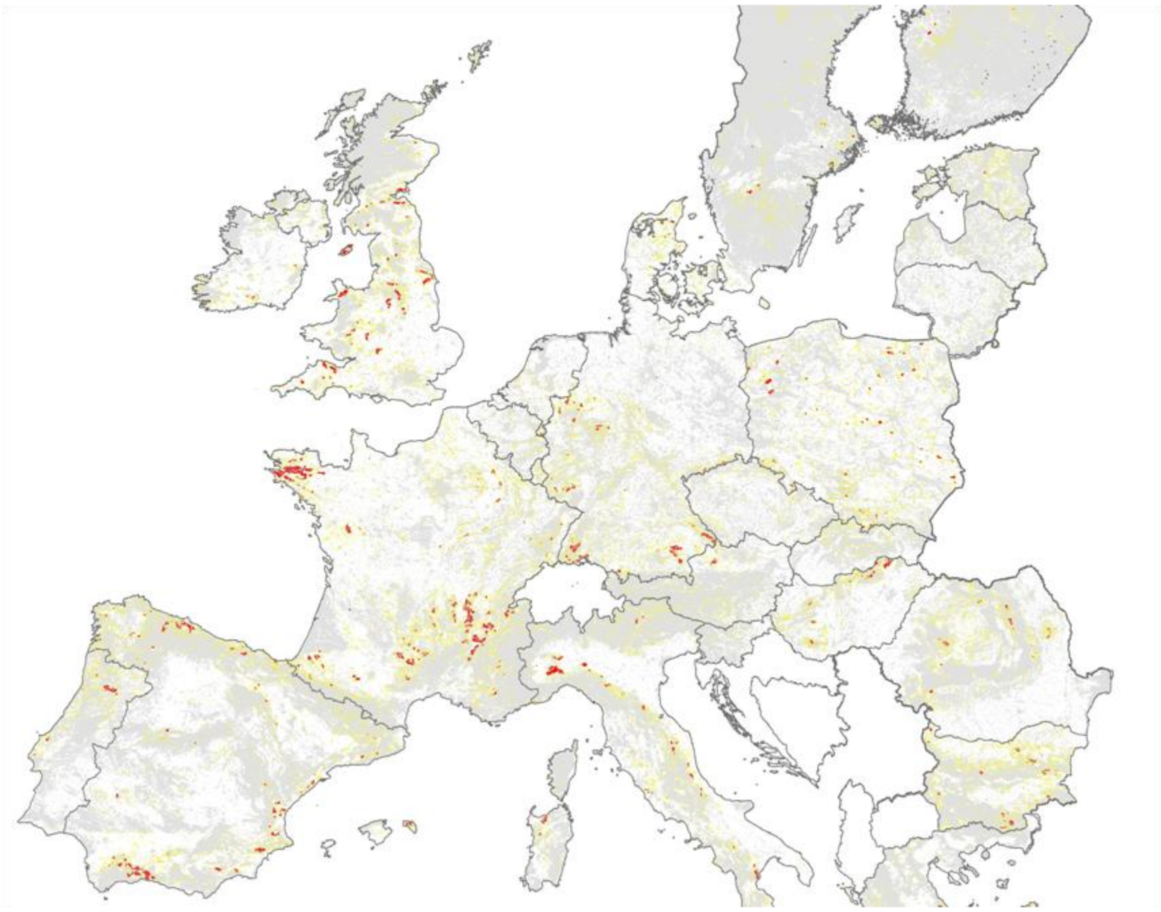
The CLUE model chain results in yearly maps of the land use pattern for the period up to 2020. While land abandonment is limited in the reference scenario and WTO scenario, extensive areas of land abandonment are observed in the other two scenarios. The results are summarized below for the process of land abandonment under Scenario 3, indicating hot-spots of land abandonment (Figure 1). Corresponding to the CAPRI results these areas of land abandonment are mainly found in the mountain regions of Europe. However, the spatial detail of the CLUE simulations reveals that within mountain regions variation exists. While agricultural land use remains in the valleys and the plateau areas of some regions, the steeper slopes are abandoned. This form of abandonment has been an ongoing process.

In the dry Mediterranean climates shrubland is in some cases the climax vegetation. Succession may further be slowed down by irregular grazing of goats and sheep that is common in many of the southern areas facing land abandonment. However, although accounted for to some extent in the model simulations, it is less likely that remote areas are irregularly grazed given the labour intensity of such livestock management systems.

Biodiversity change overlap to a large extent (though not completely) with the patterns of agricultural abandonment. In most cases, areas with high abandonment rates report significant increases in the Mean Species Abundance index. At this stage it is useful to reiterate what the index shows. In short, the MSA is an index for the biodiversity level of a location based on discounting the undisturbed level of biodiversity (where MSA=1) for influences due to land use change, fragmentation etc. In particular, the index is highly sensitive to fragmentation and ecosystem type. This means that (semi-) natural land covers normally have higher species abundance. In addition, land abandonment often reduces the fragmentation of the natural ecosystems raising the MSA. Therefore a strong correlation between MSA and land abandonment might be expected. Past abandonment in a number of mountain regions has already resulted in increased viability of habitats for a number of species that require relatively large undisturbed areas (e.g. bears and wolves in the Carpathians). However, at the same time (dry) mountain grasslands are considered to have high biological diversity as well and add to the overall diversity of the agro-ecosystem in these regions. Land abandonment mostly leads to a loss of such systems. Therefore, commonly a tradeoff between the diversity of (semi-) natural ecosystems and agro-ecosystems is observed upon land abandonment with diverging opinions on its benefits to society and the ecosystem as a whole. The loss of diversity in mountain landscapes also has drawbacks for other ecosystem services provided in these areas such as protection of the cultural heritage and landscape esthetics that attract tourists.

At the same time some decreases in biodiversity index are observed mainly related to further urbanization, which leads to drastic decreases in biodiversity value and fragmentation of habitats.

Figure 1 Projected Areas of Land Abandonment under Scenario 3



Note: Red Areas represent Hotspots of Abandonment whilst Yellow represent concentrated areas of abandonment

The erosion index exhibits a similar pattern as the MSA and abandonment. However, in this case the changes match closely with the areas of high erosion sensitivity: the steep mountain regions especially in Southern Europe that face strong, irregular, rainfall events. When the most sensitive locations for erosion overlap mostly with the least profitable locations for agricultural production, land abandonment results in a more than proportional improvement in soil sustainability. It is though worth noting that in the baseline and WTO scenarios, that show relatively little net abandonment, a major improvement in soil sustainability is achieved. This is the result of continuing land abandonment at the most marginal locations and concentration of agricultural practices in the more favourable regions such as the valleys. These small changes and rearrangements of farming practices do have a major influence on the erosion indicator.

III. Discussion

On the one hand, the results of the modeling exercise paint quite a positive picture of the impact of agricultural and trade reforms on EU agriculture. Overall production levels are unlikely to change markedly and the proportion of land potentially leaving agriculture is relatively small. In addition, there appear to be potential economic (efficiency) and environmental gains (lower overall greenhouse gas emissions, reduced nutrient surpluses) to be had from wider reforms of agricultural and trade policy. Further, there are potential environmental benefits arising from the process of abandonment itself (such as improvements in non-farm biodiversity and reduced erosion).

On the other hand, whilst production is not markedly changed, overall GVA is predicted to fall by around 20 per cent in the EU27 (and by a higher percentage in the new member states). In addition, although overall nutrient surpluses decline, there is evidence that intensification will occur on the land remaining in production, potentially increasing the pollution risk. The bias in the biodiversity indicator (MSA) towards (semi) natural biodiversity rather than farmland biodiversity also need to be taken into account. The predicted cessation of farming in many high nature value areas is likely to lead to a loss in farmland biodiversity. This is due to the fact that the reforms are predicted to hit the more extensive forms of agriculture (grazing beef and sheep) with significant areas on these farms predicted to go out of production. These systems are intimately linked with the maintenance of farmland biodiversity. Though not conclusive the results also hint at other changes in land-use that might be detrimental to biodiversity. It appears that arable production will decline markedly in areas that have been traditionally mixed (for example in parts of Germany). As McCracken and Klockenberg (1996) note, scientists are generally agreed that mixed farms are important for supporting farmland biodiversity and therefore a process of specialisation may reduce overall biodiversity in these areas.

An important question is the extent that the models are able to truly capture the complex processes that lead to land-use change and ultimately land abandonment (Keenleyside and Tucker, 2010). As the model results are largely based on a comparison of the farming conditions in marginal areas and other regions, they may underestimate the extent of abandonment in marginal areas because it ignores the changing demographic situation in many of these regions. The fact that the farmer population is aging and coupled with a shortage of successors suggests that many of these regions will have higher rates of land abandonment in the future. However, Keenleyside and Tucker (2010) put forward a counter argument stating that 'the models may be overly deterministic, as they do not take into account social and cultural factors that may encourage the continuation of uneconomic farming activities, such as use of the land for recreation, and the desire to continue cultural or family traditions and stay in the community.' (Keenleyside and Tucker 2010 p72). They also argue that some areas that are stated as being abandoned may in fact be areas that are subject to very low levels of management (and may therefore be only semi-abandoned) or be areas that are planted with trees (eg under afforestation programmes) and under active management. What is unknown is the extent to which these omitted factors cancel each other out, though Keenleyside and Tucker argue that they are likely to balance out to some extent.

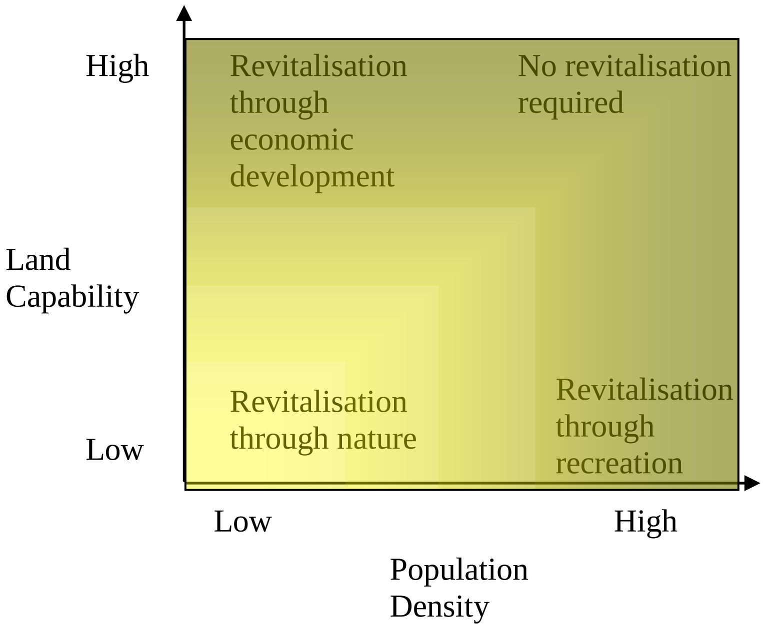
Whether or not the model estimates are conservative, land abandonment is likely to be an important factor in specific areas of Europe and for particular types of farming. In addition available evidence also highlights that abandonment itself can have a wide range of implications both positive and negative. Therefore as the FAO (2006) note this is likely to call for some form of policy response. The nature of this response will vary across regions as the reasons for abandonment can be differentiated as follows: natural constraints, land degradation, socio-economic factors, demographic structure, and institutional framework (FAO, 2006, p2).

The FAO (2006) note that, taking into account the reasons for land abandonment and depopulation, there are different opportunities for intervention to revitalise areas with varying probabilities of success. For example they argue that:

- Natural constraints cannot be influenced but can only be compensated for.
- Degradation processes can sometimes be reversed through technical interventions.
- Demographic development can only be influenced to a limited extent and;
- Socio-economic factors and institutional frameworks can be addressed by appropriate policies, however, sometimes these generate undesired side effects (FAO, 2006, p12).

Figure 2 summarises the FAO view on how the problems of marginal areas may be tackled when considered in two dimensional space, relating to extent of land capability and population density.

Figure 2 Representation of FAO classification of approaches to revitalising marginal areas



However, this broader approach is clearly beyond agricultural policy. More directly, in terms of the future of the CAP, there are challenges in dealing with land abandonment. Whilst 'greening' the CAP and moving towards paying for public goods could in theory be a way to offset any negative effects of land abandonment, there are challenges in this approach. For example, the recent Pack inquiry in Scotland (SG, 2010) has advocated that those receiving support must maintain minimum stocking rates. However, forcing farms to have minimum stocking rates when production is unprofitable may mean their income will be lower than under full decoupling. There is also a very real danger that by providing sufficient support to enable the least profitable producers to stay in production will prevent structural change from occurring and the industry could become fossilised in an uncompetitive state. It is this balance between maintaining production in areas where it is deemed environmentally important, but still enabling agriculture to become more efficient that is the key policy challenge.

IV. Conclusion

This paper has investigated the impact of agricultural and trade reform on land-use across Europe focusing on the issue of land abandonment. Three reform scenarios were considered using a modified version of the CAPRI model which accounts for the movement of land in and out of agriculture as well as between enterprises (crops and grass). The CAPRI model is linked to the Dyna-CLUE model framework to enable the spatial impacts of reforms to be assessed in greater resolution. The analysis has highlighted that the overall impact of agriculture and trade reform on production within the EU is likely to be relatively small, with around 7 per cent more land predicted to be unfarmed when compared with the baseline situation. However, a more disaggregated analysis highlights more significant declines in particular countries, regions and farm types.

The analysis has highlighted that there are potential economic (efficiency) and environmental gains (lower overall greenhouse gas emissions, reduced nutrient surpluses, reduced erosion etc) to be had from wider reforms of agricultural and trade policy. In addition, there are potential environmental benefits arising from the process of abandonment itself. On the other hand, there is likely to be a loss of semi-natural farmland (the areas perhaps most at risk of abandonment) leading to a further decline in farmland biodiversity across Europe. For some countries, a process of specialisation in production and simplification of the landscape will also occur which is also detrimental from a farmland biodiversity perspective.

Following the arguments of the FAO (2006) it is argued that simply designing agricultural policy to maintain land in production is likely to be an ineffective and inefficient way to address the perceived negative consequences of abandonment. A more holistic approach to rural development is required tailored to the specific context within each area.

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